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HARTMAN AND HARTMAN, P.C. 552 EAST 700 NORTH VAIPARAISO, IN 46383			MARKHAM, WESLEY D	
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Please find below and/or attached an Office communication concerning this application or proceeding.

<b>Office Action Summary</b>	<b>Application No.</b> 09/524,227	<b>Applicant(s)</b> SPITSBERG, IRENE T.	
	<b>Examiner</b> Wesley D Markham	<b>Art Unit</b> 1762	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 16 January 2004.
- 2a) ☒ This action is **FINAL**.                      2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-20 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-20 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 13 March 2000 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All    b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- |  |   |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)  | 4) <input type="checkbox"/> Interview Summary (PTO-413)<br>Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)                                   | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152)             |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)<br>Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____  |

## **DETAILED ACTION**

### ***Response to Amendment***

1. Acknowledgement is made of the amendment filed by the applicant on 1/16/2004 in which the specification of the instant application was amended, Claims 1, 3, 6 – 11, and 15 – 20 were amended, and non-elected Claims 21 – 39 were canceled. Claims 1 – 20 are currently pending in U.S. Application Serial No. 09/524,227, and an Office Action on the merits follows.

### ***Election/Restrictions***

2. Applicant's confirmed election of Group I, Claims 1 – 20, in the response filed on 1/16/2004 is acknowledged. Because applicant did not distinctly and specifically point out the supposed errors in the restriction requirement, the election has been treated as an election without traverse (MPEP § 818.03(a)).

### ***Drawings***

3. The objection to the drawings, set forth in paragraph 6 of the previous Office Action (i.e., the non-final Office Action, mailed on 9/16/2003), is withdrawn in light of the applicant's amendment to insert reference number "4" into the specification. As such, the formal drawings (4 sheets, 9 total figures) filed on 3/13/2000 are approved by the examiner.

***Specification***

4. The objections to the specification, set forth in paragraph 7 of the previous Office Action, are withdrawn in light of the applicant's amendment to correct a typographical error and capitalize the trademarks recited in the present application. The examiner notes that the word "of" still appears to be misspelled "f" on page 7, line 23 of the specification. However, the applicant states that they were unable to find the aforementioned misspelling and that the error may have occurred during transcription of the application from the applicant to the USPTO. As such, an examiner's amendment can be used to correct the typographical error at an appropriate time, as suggested by the applicant.

***Claim Objections***

5. The objection to Claim 20, set forth in paragraph 8 of the previous Office Action, is withdrawn in light of the applicant's amendment in which a typographical error was corrected.

***Claim Rejections - 35 USC § 112***

6. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

7. The rejection of Claim 20 under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter

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which applicant regards as the invention, set forth in paragraph 11 of the previous Office Action, is withdrawn in light of the applicant's amendment to the claim replacing the phrase "the new grains" with the phrase "the equiaxed grains".

***Claim Rejections - 35 USC § 103***

8. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

9. Claims 1 and 4 – 10 are rejected under 35 U.S.C. 103(a) as being unpatentable over the applicant's admitted prior art (AAPA) in view of Nakamura et al. (JP 01-180959 A).
10. Regarding independent **Claim 1**, the AAPA teaches a method of making a thermal barrier coating (TBC) system by depositing a diffusion aluminide bond coat that adheres the thermal barrier coating to a surface of a superalloy component, the method comprising the step of depositing the diffusion aluminide bond coat on the component so as to be characterized by substantially columnar grains that extend substantially through the portion of the bond coat overlying the surface of the component, the grains having grain boundaries exposed at the surface of the aluminide bond coat, and depositing a ceramic layer on the surface of the aluminide bond coat to form a thermal barrier coating (See "PRIOR ART" Figures 2 – 5, page

8, lines 8 – 34, page 9, lines 1 – 35, and page 10, lines 1 – 24, of the applicant's specification, which depict and describe a TBC system of a type known in the art). The AAPA does not explicitly teach improving the thermal fatigue life of the TBC by modifying the grain structure of the aluminide bond coat by recrystallizing at least a surface region of the aluminide bond coat during or prior to depositing the TBC on the surface of the bond coat, wherein new grains form at the surface of the bond coat. Nakamura et al. teaches that, after depositing a diffusion coating layer of Al (i.e., an aluminide bond coat) on the surface of a gas turbine component such as a blade (i.e., a process analogous to that taught by the AAPA), the diffusion coating layer is shot-peened and then heated to a temperature at or above the recrystallization temperature of the coating layer, thereby causing recrystallized grains (i.e., "new grains") to form on the surface of the diffusion coating layer (Abstract). This recrystallization process advantageously allows the component / coating (1) to have an improved thermal fatigue resistance without deteriorating the corrosion resistance, (2) to have a low crack propagation speed due to the small grain size of the recrystallized grains, and (3) to have an increased resistance to the coating layer peeling-off (Abstract). Therefore, it would have been obvious to one of ordinary skill in the art to improve the thermal fatigue life of the TBC system of the AAPA by modifying the grain structure of the aluminide bond coat by recrystallizing at least a surface region of the aluminide bond coat during or prior to depositing the TBC on the surface of the bond coat, wherein new grains form at the surface of the bond coat, as taught by Nakamura et al., with the reasonable expectation of

successfully and advantageously providing the coated superalloy component / blade of the AAPA with the following benefits: (1) an improved thermal fatigue resistance, (2) a lower crack propagation speed, and (3) an increased resistance to the peeling-off of the coating layer (i.e., the TBC system).

11. The combination of the AAPA and Nakamura et al. also teaches all the limitations of **Claims 4 – 10** as set forth above in paragraph 10 and below, including a method wherein / further comprising:

- Claim 4: The new grains have a grain size of not smaller than 5 micrometers after recrystallization. Specifically, although Nakamura et al. teaches that the new grains are “small” and “fine” (Abstract), Nakamura et al. is silent as to the specific size of the recrystallized grains. However, the combination of the AAPA and Nakamura et al. teaches each and every process step and limitation of the applicant's claims, including the type of aluminide bond coat utilized, the step of peening the bond coat prior to heat-treating the bond coat, and the step of recrystallizing the bond coat by heating the bond coat at a temperature at or above the recrystallization temperature. Since the grain size obtained by the applicant's claimed process is simply a function of the recrystallization (i.e., peening / heating) process utilized by the applicant, and the combination of the AAPA and Nakamura et al. teaches the claimed recrystallization (i.e., peening / heating) process, the process of the combination of the AAPA and Nakamura et al. would have inherently produced new grains having a grain size of not smaller than 5 micrometers

unless essential process steps and/or limitations are missing from the applicant's claims.

- Claim 5: The new grains are substantially equiaxed. Specifically, Nakamura et al. is silent regarding the orientation of the recrystallized grains. However, the combination of the AAPA and Nakamura et al. teaches each and every process step and limitation of the applicant's claims, including the type of aluminide bond coat utilized, the step of peening the bond coat prior to heat-treating the bond coat, and the step of recrystallizing the bond coat by heating the bond coat at a temperature at or above the recrystallization temperature. Since the grain orientation obtained by the applicant's claimed process is simply a function of the recrystallization (i.e., peening / heating) process utilized by the applicant, and the combination of the AAPA and Nakamura et al. teaches the claimed recrystallization (i.e., peening / heating) process, the process of the combination of the AAPA and Nakamura et al. would have inherently produced substantially equiaxed grains unless essential process steps and/or limitations are missing from the applicant's claims.
- Claim 6: The aluminide bond coat is a single-phase or two-phase aluminide prior to recrystallization (page 9, lines 17 – 22, of the applicant's specification).
- Claim 7: Precipitates are present in the grain boundaries of the grains after the depositing step and before recrystallization (see, for example, page 9, lines 29 – 35 of the specification), and the precipitates are substantially



absent from the grain boundaries of the new grains after recrystallization.

Specifically, the combination of the AAPA and Nakamura et al. is silent regarding precipitates at the grain boundaries after recrystallization. However, the combination of the AAPA and Nakamura et al. teaches each and every process step and limitation of the applicant's claims, including the type of aluminide bond coat utilized, the step of peening the bond coat prior to heat-treating the bond coat, and the step of recrystallizing the bond coat by heating the bond coat at a temperature at or above the recrystallization temperature. Since the lack of grain boundary precipitates obtained in the applicant's claimed process is simply a function of the recrystallization (i.e., peening / heating) process utilized by the applicant, and the combination of the AAPA and Nakamura et al. teaches the claimed recrystallization (i.e., peening / heating) process, the process of the combination of the AAPA and Nakamura et al. would have inherently produced a bond coat having substantially no precipitates at the grain boundaries after recrystallization unless essential process steps and/or limitations are missing from the applicant's claims.

- Claim 8: The aluminide bond coat is single-phase aluminide after recrystallization. Specifically, the AAPA teaches that the bond coat, as deposited, is a single-phase or two-phase diffusion aluminide (page 9, lines 17 – 19, of the applicant's specification). Additionally, the combination of the AAPA and Nakamura et al. teaches each and every process step and limitation of the applicant's claims, including the type of aluminide bond coat

deposited, the step of peening the bond coat prior to heat-treating the bond coat, and the step of recrystallizing the bond coat by heating the bond coat at a temperature at or above the recrystallization temperature. Since the single phase aluminide obtained in the applicant's claimed process is simply a function of the recrystallization (i.e., peening / heating) process utilized by the applicant (for support, see, for example, page 14, lines 18 – 20 of the applicant's specification, which indicates that a bond coat recrystallization process yields a single-phase), and the combination of the AAPA and Nakamura et al. teaches the claimed recrystallization (i.e., peening / heating) process, the process of the combination of the AAPA and Nakamura et al. would have inherently produced a bond coat having a single-phase aluminide structure unless essential process steps and/or limitations are missing from the applicant's claims.

- Claim 9: Following the depositing step, the surface of the aluminide bond coat has surface irregularities as a result of grain boundary ridges defined by the grain boundaries at the surface of the aluminide bond coat (AAPA at Figure 2, page 9, lines 1 – 35, and page 10, lines 1 – 7), and following the recrystallizing step, the new grains cause the surface of the bond coat to be smoother and flatter as a result of eliminating at least some of the grain boundary ridges, whereby the ceramic layer is deposited on the smoother and flatter surface of the aluminide bond coat. Specifically, the combination of the AAPA and Nakamura et al. teaches each and every process step and

limitation of the applicant's claims, including the type of aluminide bond coat deposited, the step of peening the bond coat prior to heat-treating the bond coat, and the step of recrystallizing the bond coat by heating the bond coat at a temperature at or above the recrystallization temperature. Since the flattened grain boundary ridges and smoother bond coat surface obtained in the applicant's claimed process is simply a function of the recrystallization (i.e., peening / heating) process utilized by the applicant, and the combination of the AAPA and Nakamura et al. teaches the claimed recrystallization (i.e., peening / heating) process, the process of the combination of the AAPA and Nakamura et al. would have inherently produced a bond coat having flattened grain boundary ridges and a smoother bond coat surface on which the ceramic layer is deposited, as required by Claim 9.

- Claim 10: The aluminide bond coat is a platinum aluminide bond coat (page 9, lines 11 – 19 of the applicant's specification).

12. Claims 2, 11, and 13 – 18, and 20 are rejected under 35 U.S.C. 103(a) as being unpatentable over the applicant's admitted prior art (AAPA) in view of Nakamura et al. (JP 01-180959 A), and in further view of Loersch et al. (USPN 4,514,469).
13. The combination of the AAPA and Nakamura et al. teaches all the limitations of **Claim 2** as set forth above in paragraph 10, except for a method wherein the recrystallization is induced by peening the bond coat at an intensity of at least 6A prior to heating the bond coat. Specifically, Nakamura et al. teaches inducing the

recrystallization by peening the bond coat prior to heating the bond coat (Abstract) but does not explicitly teach the claimed peening intensity. As verified by an oral translation from a USPTO translator, Nakamura et al. is silent regarding the specific peening intensity. However, it is clear that the peening intensity of Nakamura et al. must be high enough to induce plastic deformation to the diffusion coating layer (Abstract). Loersch et al. teaches that, in the art of peening bond coatings on metal workpieces such as turbine airfoils, the peening intensity must be high enough to achieve a good surface finish (e.g., closure of surface defects) in an economical period of time, but not so high as to chip or physically degrade the coating (Col.6, lines 54 – 68, and Col.7, lines 1 – 21). In other words, Loersch et al. teaches that the peening intensity is a result / effective variable that must be chosen / optimized to be high (i.e., to achieve a good surface finish in a short amount of time) but not too high (i.e., so that the coating or workpiece is not damaged). Therefore, it would have been obvious to one of ordinary skill in the art to optimize the peening intensity of the process of the combination of the AAPA and Nakamura et al. as a result / effective variable through routine experimentation in order to obtain a peening intensity that is high enough to achieve a good surface finish (i.e., high enough to provide the plastic deformation desired by Nakamura et al.) but not so high as to damage the aluminide bond coating or the workpiece itself.

14. Regarding independent **Claims 11 and 20**, the AAPA teaches a method of making a thermal barrier coating (TBC) system by depositing an aluminide bond coat, specifically a diffusion aluminide bond coat, that adheres the thermal barrier coating

to a surface of a superalloy component, the method comprising the steps of depositing the diffusion aluminide bond coat on the component by VPA or CVD, the bond coat comprising an additive layer on the surface of the component and a diffusion zone in a surface region of the component, the additive layer being characterized by substantially columnar grains that extend from the diffusion zone to the surface of the bond coat, the grains having grain boundaries exposed at the surface of the aluminide bond coat, and then depositing a ceramic layer to form the TBC on the bond coat (See "PRIOR ART" Figures 2 – 5, page 8, lines 8 – 34, page 9, lines 1 – 35, and page 10, lines 1 – 24, of the applicant's specification, which depict and describe a TBC system of a type known in the art). The AAPA does not explicitly teach improving the thermal fatigue life of the TBC by modifying the grain structure of the (diffusion) aluminide bond coat by (1) peening the bond coat at an intensity of at least 6A (Claim 11), specifically at an intensity of 6A to 12A (Claim 20), (2) heat treating the bond coat before depositing the TBC on the surface of the bond coat so as to recrystallize at least a surface region of the bond coat, wherein new grains form within the additive layer at the surface of the bond coat (Claim 11), specifically heat treating at a temperature and for a duration sufficient to recrystallize the entire additive layer of the bond coat, wherein equiaxial grains form within the additive layer (Claim 20), and (3) producing new, equiaxed grains that have a grain size of about 15 to 30 micrometers (Claim 20). Nakamura et al. teaches that, after depositing a diffusion coating layer of Al (i.e., a diffusion aluminide bond coat) on the surface of a gas turbine component such as a blade (i.e., a process analogous to

that taught by the AAPA), the diffusion coating layer is shot-peened and then heated to a temperature at or above the recrystallization temperature of the coating layer, thereby causing recrystallized grains (i.e., "new grains") to form on the surface of the diffusion coating layer (i.e., in the additive layer of the diffusion aluminide bond coat) (Abstract). This recrystallization process advantageously allows the component / coating (1) to have an improved thermal fatigue resistance without deteriorating the corrosion resistance, (2) to have a low crack propagation speed due to the small grain size of the recrystallized grains, and (3) to have an increased resistance to the coating layer peeling-off (Abstract). Therefore, it would have been obvious to one of ordinary skill in the art to improve the thermal fatigue life of the TBC system of the AAPA by modifying the grain structure of the aluminide bond coat by recrystallizing at least a surface region of the aluminide bond coat prior to depositing the TBC on the surface of the bond coat, wherein new grains form at the surface of the bond coat, as taught by Nakamura et al., with the reasonable expectation of successfully and advantageously providing the coated superalloy component / blade of the AAPA with the following benefits: (1) an improved thermal fatigue resistance, (2) a lower crack propagation speed, and (3) an increased resistance to the peeling-off of the coating layer (i.e., the TBC system). The combination of the AAPA and Nakamura et al. does not explicitly teach the applicant's claimed peening intensity. However, it would have been obvious to one of ordinary skill in the art to optimize the peening intensity of the combination of the AAPA and Nakamura et al. through routine experimentation in light of the teachings of Loersch et al. (see paragraph 13 above).

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Regarding Claim 20, the combination of the AAPA, Nakamura et al., and Loersch et al. does not explicitly teach that the entire additive layer of the bond coat is recrystallized by the heat-treatment step. However, Nakamura et al. does teach that the outermost surface of the diffusion coating layer is recrystallized (Abstract). This "outermost surface of the diffusion coating layer" appears to correspond to the "additive layer" of the AAPA (i.e., as opposed to the diffusion zone portion of the diffusion coating, which is located within the component itself). It would have been obvious to one of ordinary skill in the art to heat-treat the diffusion bond coating of the AAPA for a temperature and time sufficient to recrystallize the entire additive layer of the bond coat with the reasonable expectation of successfully and advantageously maximizing the benefits of the recrystallization taught by Nakamura et al., such as providing the entire additive layer with a relatively small grain size, thereby most effectively retarding crack propagation. Further regarding Claim 20, the combination of the AAPA, Nakamura et al., and Loersch et al. does not explicitly teach that the new grains are equiaxial and have a grain size of from 15 to 30 micrometers. Specifically, the aforementioned combination is silent regarding the orientation and size of the recrystallized grains. However, the combination of the AAPA, Nakamura et al., and Loersch et al. teaches each and every process step and limitation of the applicant's claims, including the type of aluminide bond coat utilized, the step of peening the bond coat prior to heat-treating the bond coat, and the step of recrystallizing the bond coat by heating the bond coat at a temperature at or above the recrystallization temperature. Since the grain orientation and size

obtained by the applicant's claimed process is simply a function of the recrystallization (i.e., peening / heating) process utilized by the applicant, and the combination of the AAPA, Nakamura et al., and Loersch et al. teaches the claimed recrystallization (i.e., peening / heating) process, the process of the combination of the AAPA, Nakamura et al., and Loersch et al. would have inherently produced equiaxial grains having a size of from 15 to 30 micrometers, unless essential process steps and/or limitations are missing from the applicant's claims. Additionally, the combination of the AAPA, Nakamura et al., and Loersch et al. teaches that the surface of the aluminide bond coat has surface irregularities as a result of grain boundary ridges defined by the grain boundaries at the surface of the aluminide bond coat (AAPA at Figure 2, page 9, lines 1 – 35, and page 10, lines 1 – 7), and following the recrystallizing step, the new, equiaxed grains cause the surface of the bond coat to be smoother and flatter as a result of eliminating at least some of the grain boundary ridges, whereby the ceramic layer is deposited on the smoother and flatter surface of the aluminide bond coat. Specifically, the combination of the AAPA Nakamura et al., and Loersch et al. teaches each and every process step and limitation of the applicant's claims, including the type of aluminide bond coat deposited, the step of peening the bond coat prior to heat-treating the bond coat, and the step of recrystallizing the bond coat by heating the bond coat at a temperature at or above the recrystallization temperature. Since the flattened grain boundary ridges and smoother bond coat surface obtained in the applicant's claimed process is simply a function of the recrystallization (i.e., peening / heating) process



utilized by the applicant, and the combination of the AAPA, Nakamura et al., and Loersch et al. teaches the claimed recrystallization (i.e., peening / heating) process, the process of the combination of the AAPA, Nakamura et al., and Loersch et al. would have inherently produced a bond coat having flattened grain boundary ridges and a smoother bond coat surface on which the ceramic layer / TBC is deposited, as required by Claims 11 and 20.

15. The combination of the AAPA, Nakamura et al., and Loersch et al. also teaches all the limitations of **Claims 13 – 18** as set forth above in paragraph 14 and below, including a method wherein / further comprising:

- Claim 13: The new grains have a grain size of not smaller than 5 micrometers after the TBC has been deposited. Specifically, although Nakamura et al. teaches that the new grains are “small” and “fine” (Abstract), Nakamura et al. is silent as to the specific size of the recrystallized grains. However, the combination of the AAPA, Nakamura et al., and Loersch et al. teaches each and every process step and limitation of the applicant’s claims, including the type of aluminide bond coat utilized, the step of peening the bond coat prior to heat-treating the bond coat, and the step of recrystallizing the bond coat by heating the bond coat at a temperature at or above the recrystallization temperature. Since the grain size obtained by the applicant’s claimed process is simply a function of the recrystallization (i.e., peening / heating) process utilized by the applicant, and the aforementioned combination of references teaches the claimed recrystallization (i.e., peening / heating) process, the

process of the combination references would have inherently produced new grains having a grain size of not smaller than 5 micrometers unless essential process steps and/or limitations are missing from the applicant's claims.

- Claim 14: The new grains are substantially equiaxed. Specifically, Nakamura et al. is silent regarding the orientation of the recrystallized grains. However, the combination of the AAPA, Nakamura et al., and Loersch et al. teaches each and every process step and limitation of the applicant's claims, including the type of aluminide bond coat utilized, the step of peening the bond coat prior to heat-treating the bond coat, and the step of recrystallizing the bond coat by heating the bond coat at a temperature at or above the recrystallization temperature. Since the grain orientation obtained by the applicant's claimed process is simply a function of the recrystallization (i.e., peening / heating) process utilized by the applicant, and the combination of references teaches the claimed recrystallization (i.e., peening / heating) process, the process of the combination of references would have inherently produced substantially equiaxed grains unless essential process steps and/or limitations are missing from the applicant's claims.
- Claim 15: The aluminide bond coat is a single-phase or two-phase aluminide prior to recrystallization (page 9, lines 17 – 22, of the applicant's specification).
- Claim 16: Precipitates are substantially absent from the grain boundaries of the new grains after recrystallization. Specifically, the combination of the

AAPA, Nakamura et al., and Loersch et al. is silent regarding precipitates at the grain boundaries after recrystallization. However, the aforementioned combination of references teaches each and every process step and limitation of the applicant's claims, including the type of aluminide bond coat utilized, the step of peening the bond coat prior to heat-treating the bond coat, and the step of recrystallizing the bond coat by heating the bond coat at a temperature at or above the recrystallization temperature. Since the lack of grain boundary precipitates obtained in the applicant's claimed process is simply a function of the recrystallization (i.e., peening / heating) process utilized by the applicant, and the combination of the AAPA, Nakamura et al., and Loersch et al. teaches the claimed recrystallization (i.e., peening / heating) process, the process of the aforementioned combination of references would have inherently produced a bond coat having substantially no precipitates at the grain boundaries after recrystallization unless essential process steps and/or limitations are missing from the applicant's claims.

- Claim 17: The aluminide bond coat is single-phase aluminide after recrystallization. Specifically, the AAPA teaches that the bond coat, as deposited, is a single-phase or two-phase diffusion aluminide (page 9, lines 17 – 19, of the applicant's specification). Additionally, the combination of the AAPA, Nakamura et al., and Loersch et al. teaches each and every process step and limitation of the applicant's claims, including the type of aluminide bond coat deposited, the step of peening the bond coat prior to heat-treating

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the bond coat, and the step of recrystallizing the bond coat by heating the bond coat at a temperature at or above the recrystallization temperature.

Since the single phase aluminide obtained in the applicant's claimed process is simply a function of the recrystallization (i.e., peening / heating) process utilized by the applicant (for support, see, for example, page 14, lines 18 – 20 of the applicant's specification, which indicates that a bond coat recrystallization process yields a single-phase), and the combination of the AAPA, Nakamura et al., and Loersch et al. teaches the claimed recrystallization (i.e., peening / heating) process, the process of the combination of the AAPA, Nakamura et al., and Loersch et al. would have inherently produced a bond coat having a single-phase aluminide structure unless essential process steps and/or limitations are missing from the applicant's claims

- Claim 18: The aluminide bond coat is a platinum aluminide bond coat (page 9, lines 11 – 19 of the applicant's specification).

16. Claim 3 is rejected under 35 U.S.C. 103(a) as being unpatentable over the applicant's admitted prior art (AAPA) in view of Nakamura et al. (JP 01-180959 A), and in further view of Duhl et al. (USPN 4,512,817).

17. The combination of the AAPA and Nakamura et al. teaches all the limitations of **Claim 3** as set forth above in paragraph 10, except for a method wherein the aluminide bond coat is heated to a temperature of about 1090° C to about 1120° C

during the recrystallizing step. Specifically, Nakamura et al. teaches heating the bond coat to a temperature at or above the recrystallization temperature of the coating (Abstract) and gives a specific example of heating to a temperature of 900° C (sections (9) and (10) of Nakamura et al., as verified by an oral translation from a USPTO translator). Duhl et al. teaches that the temperature of the post-deposition heat treatment of a bond coating is a result / effective variable that depends on various factors such as (1) the amount of coating interdiffusion desired, (2) the type of coating, (3) the substrate composition, and (4) the coating thickness (Col.3, lines 8 – 40). A high heat treatment temperature such as 2050° F (i.e., 1121° C – “about 1120° C”, as claimed by the applicant) can be utilized (Col.4, lines 7 – 16). It would have been obvious to one of ordinary skill in the art to utilize a high heat treatment temperature of, for example, about 1120° C (as taught by Duhl et al.), in the process of the combination of the AAPA and Nakamura et al. with the reasonable expectation of (1) success, as Nakamura et al. teaches heating the bond coat to a temperature at or above the recrystallization temperature of the coating (i.e., does not appear to place an upper limit on the heat treatment temperature) and (2) obtaining the benefit of using a higher heat treatment temperature than the 900° C temperature explicitly taught by Nakamura et al., such as performing the recrystallization more quickly, thereby increasing process throughput.

18. Claim 12 is rejected under 35 U.S.C. 103(a) as being unpatentable over the applicant's admitted prior art (AAPA) in view of Nakamura et al. (JP 01-180959 A), in

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further view of Loersch et al. (USPN 4,514,469), and in further view of Duhl et al. (USPN 4,512,817).

19. The combination of the AAPA, Nakamura et al., and Loersch et al. teaches all the limitations of **Claim 12** as set forth above in paragraph 14, except for a method wherein the aluminide bond coat is heated to a temperature of about 1090° C to about 1120° C. However, this limitation would have been obvious to one of ordinary skill in the art in view of the teachings of Duhl et al. (see paragraph 17 above).

20. Claim 19 is rejected under 35 U.S.C. 103(a) as being unpatentable over the applicant's admitted prior art (AAPA) in view of Nakamura et al. (JP 01-180959 A), in further view of Loersch et al. (USPN 4,514,469), and in further view of Duderstadt et al. (USPN 5,238,752).

21. The combination of the AAPA, Nakamura et al., and Loersch et al. teaches all the limitations of **Claim 19** as set forth above in paragraph 14, except for a method wherein tantalum-rich precipitates are present in the grain boundaries of the grains after the depositing step and before recrystallization, and the tantalum-rich precipitates are substantially absent from the grain boundaries of the new grains after recrystallization. However, the AAPA does teach that refractory phases "46" (i.e., precipitates) are present in the grain boundaries "34" of the grains after the depositing step and before recrystallization (Figure 2 and page 9, lines 20 – 35, of the applicant's specification). The refractory phases form during the bond coat deposition as a result of diffusion of refractory elements from the superalloy

substrate (page 9, lines 32 – 35 of the applicant's specification). Additionally, the AAPA teaches that the substrate is a nickel or cobalt-based superalloy (page 8, lines 8 – 15, of the applicant's specification) but is silent regarding the specifics of the aforementioned superalloy. Duderstadt et al. teaches that typical nickel-based superalloy materials used to make turbine blades comprise tantalum (Col.4, lines 39 – 45, Col.8, lines 28 – 46, and Col.9, lines 35 – 43), and a certain amount of this tantalum diffuses into the bond coat from the substrate (Col.6, lines 14 – 22). It would have been obvious to one of ordinary skill in the art to utilize the specific, tantalum-containing nickel-based superalloy materials taught by Duderstadt et al. in making the nickel-based superalloy turbine blades of the AAPA, thereby performing a process in which tantalum-rich precipitates diffuse from the substrate and are present in the grain boundaries after depositing the bond coat (as taught by the AAPA and Duderstadt et al.), with the reasonable expectation of successfully and advantageously using a specific, well-known, nickel-based superalloy material (i.e., the material(s) taught by Duderstadt et al.) out of the broader genus of nickel-based superalloy materials generally taught by the AAPA in the turbine blade manufacturing process (i.e., using a known species out of a broader disclosed genus). Please note that the selection of a known material based on its suitability for its intended use supports a *prima facie* obviousness determination (See MPEP 2144.07). Additionally, the aforementioned combination of references is silent regarding tantalum-rich precipitates at the grain boundaries after recrystallization. However, the aforementioned combination of references teaches each and every

process step and limitation of the applicant's claims, including the type of aluminide bond coat utilized, the step of peening the bond coat prior to heat-treating the bond coat, and the step of recrystallizing the bond coat by heating the bond coat at a temperature at or above the recrystallization temperature. Since the lack of grain boundary precipitates obtained in the applicant's claimed process is simply a function of the recrystallization (i.e., peening / heating) process utilized by the applicant, and the aforementioned combination of references teaches the claimed recrystallization (i.e., peening / heating) process, the process of the combination of the AAPA, Nakamura et al., Loersch et al., and Duderstadt et al. would have inherently produced a bond coat having substantially no precipitates, including tantalum-rich precipitates, at the grain boundaries after recrystallization unless essential process steps and/or limitations are missing from the applicant's claims.

### ***Double Patenting***

22. Regarding the obviousness-type double patenting rejections set forth in paragraphs 29 – 32 of the previous Office Action, the applicant argues that the instant application was filed before each of the Spitsberg references, and, through no fault of the applicant (i.e., due to administrative delay), the later-filed patent issued and publication was published prior to examination of the instant application. According to MPEP 804(II)(B)(1)(b), this situation necessitates a two-way obviousness determination if the applicant could not have filed the claims in a single application. After careful consideration, the applicant's argument is convincing because (1) a



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two-way test of obviousness is required in this situation, and (2) the claims of the Spitsberg references are not obvious in view of the claims of the instant application. Therefore, the obviousness-type double patenting rejections set forth in paragraphs 29 – 32 of the previous Office Action are withdrawn.

### ***Response to Arguments***

23. Applicant's arguments filed on 1/16/2004 have been fully considered but they are not persuasive.

24. The applicant generally argues that, without the benefit of the applicant's teachings, one of ordinary skill in the art would not have any basis for a reasonable expectation that peening (and thereby smoothing) the surface of a diffusion aluminide bond coat would improve the thermal fatigue life of a TBC deposited on the bond coat because of the express teachings of the AAPA, namely that polishing a diffusion aluminide bond coat would be expected to reduce TBC life, since sufficient surface roughness of the bond coat would be desired to promote adhesion of the alumina to the bond coat, and to inhibit crack propagation through the alumina and the alumina-bond coat interface. The applicant states that nothing in Nakamura refutes this conventional wisdom (as the coating of Nakamura is not disclosed as being used as a bond coat to adhere a ceramic coating), and a person of ordinary skill in the art would not be motivated to combine the teachings of the prior art without relying on the applicant's teachings.

25. In response, the applicant's argument has been carefully considered by the examiner. To begin, the examiner agrees that the AAPA teaches that polishing a diffusion aluminide bond coat would be expected to reduce TBC life. However, this teaching of the alleged "conventional wisdom" in the art of TBC systems must be balanced against the express teachings of Nakamura et al. In this case, the purportedly reduced TBC life appears to be related to crack propagation through the alumina and the alumina-bond coat interface (see page 19 of the applicant's response). Nakamura et al. explicitly teaches that, even if cracking occurs, its speed of propagation is retarded because of the small grain size (due to the recrystallization) and, as a result, the coating layer has an increased resistance to peeling-off (Abstract). Based on this teaching, one of ordinary skill in the art would have reasonably expected the peening / heat treating (i.e., recrystallization) process of Nakamura et al. to prevent crack propagation in the diffusion aluminide bond coat of the AAPA (i.e., due to the small recrystallized grains), thereby increasing the thermal fatigue life of the bond coat specifically and the TBC system generally. This is sufficient motivation to combine the AAPA and Nakamura et al. in the manner done so by the examiner. Please note that, in making a determination of obviousness, only a reasonable expectation of success is required, not absolute predictability. Additionally, the examiner cites Warnes et al. (USPN 6,472,018 B1) to further rebut the applicant's assertion that the conventional wisdom in the art of TBC systems is that polishing a diffusion aluminide bond coat would be expected to reduce TBC life (Abstract, Figure 2, Col.1, lines 47 – 62, Col.3, lines 48 – 67, Col.4,

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lines 1 – 4 and 65 – 67, Col.5, lines 1 – 30 and 46 – 65, Col.6, lines 19 – 32, and Col.7, lines 8 – 29).

### ***Conclusion***

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office Action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Wesley D Markham whose telephone number is (571) 272-1422. The examiner can normally be reached on Monday - Friday, 8:00 AM to 4:30 PM.

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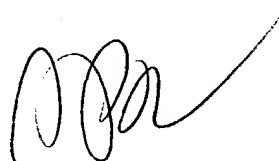
If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Shrive Beck can be reached on (571) 272-1415. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).



WDM

Wesley D Markham  
Examiner  
Art Unit 1762



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